Pardon the Interruption(s)—Enabling a Safer Emergency Department Sign Out

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ABSTRACT

Introduction: Patient "handoffs" or "sign outs" in medicine are widely recognized as highly vulnerable times for medical errors to occur. The Emergency Department (ED) has been identified as an environment where these transitions of care at shift changes are particularly high-risk due to a variety of factors, including frequent interruptions, which can further lead to errors in transfer of information. Our primary objective was to evaluate whether simple interventions could minimize interruptions during the sign out period in an attempt to improve patient safety.

Methods: Multiple low-cost interventions were implemented, including an overhead chime, clerical staff diversion of phone calls and electrocardiograms, and prominent positioning of a movable pedestal sign. Utilizing a before-and-after study design, we directly observed team sign outs at various shift changes throughout the day over 2-month periods before and after implementation. Our primary outcome measure was the number of interruptions that occurred during designated sign out times. We also assessed total time spent in sign out, and a survey was sent to clinicians to assess their perception of sign out safety.

Results: Total sign out interruptions were significantly decreased as a result of the above-noted interventions (average 6.1 vs 1.1; $P < 0.01$). Total time spent during sign out was reduced (14.1 vs 11.4 minutes; $P < 0.04$), and clinicians' perception of safety improved significantly, with Likert scores of 4 or 5 on a 5 point scale increasing from 47.4% before to 91.7% after implementation.

Conclusion: Patient sign out at shift change is a vulnerable time for patient safety and transition of care with interruptions further compromising the safe transfer of information. Simple interventions significantly decreased interruptions and were associated with shorter sign out periods and improved provider perception of sign out safety.

INTRODUCTION

The Joint Commission recognizes that failure to communicate patient information accurately between health care providers is a major source of medical errors.[1] The Emergency Department (ED) may be particularly vulnerable to errors in communication due to the high patient volume, high acuity, and fast pace. Information decay during patient handoffs is a well-described phenomenon; at-risk information includes vital signs,[2] patient history,[3] and medication administration history.[4] Provider-to-provider communication at shift change is an especially vulnerable time for interruptions to compromise patient care safety. The transfer of care occurring from a team with more familiarity with the patient to one who may feel less ownership of the patient's care could lead to information decay.

Unfortunately, shift sign out is also susceptible to frequent interruptions,[4,5] which increase the risk of error[6] and occur frequently in the ED. Prior studies show 5 to 6 interruptions per hour,[7-9] which may lead to an even greater degree of information loss than would have otherwise occurred.

Over the last 5 years, the importance of patient handoffs has received increasing recognition.[10] Improvement in data transfer from provider to provider has been achieved through the use of standardized checklists.[11,12] The Emergency Medicine Patient Safety Foundation's *SAFER Sign Out* guideline provide a standardized process of handing off information with the goal of reducing patient errors.[13] However, there has been little research done to evaluate the setting of shift sign out.

We hypothesized that simple interventions could significantly reduce the number of interruptions that occur during shift sign out and improve provider perception of sign out efficiency and safety.

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METHODS

This study was conducted at an academic, tertiary care ED with approximately 60,000 patient visits per year. Institutional Review Board exemption was sought and granted.

The ED utilizes 2 separate care teams with staggered shifts that are responsible only for adult patients. We piloted a 3-pronged simultaneous intervention: (1) an overhead chime audible through the ED signaling the start of shift sign out, (2) diversion of phone calls by clerical staff to the second care team (the team not actively signing out), and (3) a lightweight, easily movable pedestal sign with the message "Sign out Rounds in Progress, Please Minimize Interruptions" placed outside the physician work area to signify shift sign out occurring. These interventions were chosen to provide an audible cue to all staff that sign out was beginning and a visible reminder that sign out was in process and interruptions should be minimized. The diversion of phone calls (specifically calls about patients being transferred from outside facilities) provided an operational workflow change for the department clerk. All 3 interventions were initiated simultaneously in September 2013 and remain in place. Prior to implementation, an email was sent out introducing the changes to all ED staff, with messaging reinforcing the idea that sign out is a high-risk time during which interruptions should be minimized as critical patient information is being communicated. The ED does not utilize any formalized structure for sign out content; it typically is resident-to-resident with attending supervision.

Utilizing a before and after study design, a research assistant observed team sign outs at various shift changes throughout the day before the interventions (July 2013 - August 2013), and again after a 4-month washout period (January 2014 – March 2014). All sign outs observed occurred either during the 3 pm or 5 pm sign outs, which were chosen because these hours are when the department has the highest volume and the highest number of patients are likely to be signed out. Other sign outs, which occur at 7 am and 11 pm, were not observed, although the interventions were still utilized during these times. Using the data-collection form (Figure 1), the research assistant observed shift sign out and recorded each instance and type of interruption (eg, nursing interactions, electrocardiogram (ECG) deliveries, consultants, phone calls, and arrival of critically ill and/or trauma patients). Interruptions were defined as anyone outside of members of either the oncoming or offgoing team speaking to a member of either team, any member of either team being handed an ECG for interpretation, any member of either team answering a phone call during the sign out period, or the arrival or identification of a critically ill and/or trauma patient that required immediate attention.

Also recorded were the start and end times of shift sign out, number of patients signed out, total number of patients in the ED,

Figure 1. Direct Observation Template Form

Sign out Project Data Sheet
Date _____

Shift change (circle) 7a 3p 5p 11p

Time sign out begins _____

Time sign out ends _____ Total time (min) _____

Number of team members on offgoing team _____
(Residents and attendings)

Number of team members on oncoming team _____

Total patients in department _____

Total patients being signed out _____

Interruptions/Delays

(Circle)
Attending late/missing Resident late/missing

(Tally)
Phone calls _____ Nursing _____

Consultants/other providers _____ ECGs _____

Critically ill patients/traumas _____

Total interruptions _____

Figure 2. Pre- and Postintervention Survey Instrument

In the past week, how often has a sign out/patient handoff been interrupted by nursing or other ED staff?

1	2	3	4	5
Never	Rarely	Sometimes	Frequently	Very Frequently

In the past week, how often has sign out/patient handoff been interrupted by phone calls or consultants?

1	2	3	4	5
Never	Rarely	Sometimes	Frequently	Very Frequently

In the past week, how often have you needed to repeat or restart a patient handoff due to interruptions?

1	2	3	4	5
Never	Rarely	Sometimes	Frequently	Very Frequently

How efficient do you think sign outs have been in the past week?

1	2	3	4	5
Very Inefficient	Somewhat Inefficient	Neutral	Somewhat Efficient	Very Efficient

In the past week, how often did you feel that interruptions during sign out/patient handoffs has compromised patient safety?

1	2	3	4	5
Never	Rarely	Sometimes	Frequently	Very Frequently

Overall, how safe do you feel sign out has been over the past week?

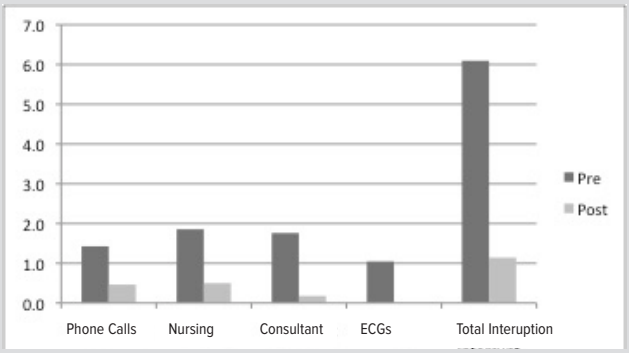
1	2	3	4	5
Not at all	Somewhat Unsafe	Neutral	Fairly Safe	Very Safe

Table. Pre- and Postintervention Likert Scale Responses by Providers

		Very Frequently	Frequently	Sometimes	Rarely	Never	*P*-value for Chi-square Test
		1	2	3	4	5	
In the past week, how often has a sign out been interrupted by nursing or other ED staff?	Pre	34.21%	28.95%	28.95%	7.89%	0.00%	<0.001
	Post	2.70%	13.51%	27.03%	54.05%	2.70%	
In the past week, how often has sign out been interrupted by phone calls or consultants?	Pre	31.58%	23.68%	36.84%	5.26%	2.63%	0.002
	Post	0.00%	22.22%	50.00%	22.22%	5.56%	
In the past week, how often have you needed to repeat or restart a patient sign out due to interruptions?	Pre	23.68%	26.32%	31.58%	13.16%	5.26%	0.002
	Post	0.00%	10.81%	43.24%	40.54%	5.41%	
In the past week, how often did you feel that interruptions during sign out/patient handoffs have compromised patient safety?	Pre	0.00%	10.53%	42.11%	34.21%	13.16%	0.026
	Post	0.00%	0.00%	21.62%	59.46%	18.92%	
		Very Inefficient	Somewhat Inefficient	Neutral	Somewhat Efficient	Very Efficient	
How effecient do you think sign out has been in the past week?	Pre	13.16%	21.05%	34.21%	31.58%	0.00%	0.002
	Post	2.70%	8.11%	13.51%	62.16%	13.51%	
		Not at all Safe	Somewhat Unsafe	Neutral	Fairly Safe	Very Safe	
		1	2	3	4	5	
Overall, how safe do you feel sign out has been over the past week?	Pre	0.00%	23.68%	28.95%	34.21%	13.16%	0.001
	Post	0.00%	2.78%	5.56%	72.22%	19.44%	

There were 38 respondents in the pre group and 37 in the post group. Chi-square test was used to calculate *P*-values.

Figure 3. Pre- and Postintervention Average Frequency of Interruptions by Type



Reduction in all categories of interruption were statistically significant.
Abbreviation: ECG, electrocardiogram.

number of team members on both the oncoming and offgoing teams, and whether faculty or residents were late to sign out.

A survey (Figure 2) was emailed to 24 faculty and 18 residents working in the ED during implementation to assess their perceptions of the frequency of interruptions during sign out and their overall perception of the efficiency and safety of sign out in the past week on a 1-5 Likert scale. The survey was sent to this group of providers both prior to the initial data collection period and again after the postintervention observation period.

Outcomes measured by direct observation and survey results were compared statistically utilizing 2-sample *t*-tests, 2-sample proportion tests, and chi-square tests as appropriate. STATA version 13 (StataCorp, College Station, Texas) was utilized for all statistical analyses.

RESULTS

Twenty-one sessions of shift sign out were directly observed prior to the intervention. Twenty-eight sessions were observed after intervention. The preintervention survey was completed by 38 of 42 providers (90.5% response rate), and the postintervention survey was completed by 37 of 42 providers (88.1% response rate).

The average frequency of preintervention interruptions was 1 occurring every 2.38 minutes. Postintervention interruptions occurred at a rate of 1 every 10.36 minutes. The average number of interruptions per shift sign out were significantly decreased by the interventions (6.1 vs 1.1 total interruptions; $P<0.001$). The frequency of all measured categories of observed interruptions were reduced during the sign out process, including nursing interactions ($P=0.01$), consultant interactions ($P=0.02$), ECG delivery ($P=0.001$), and phone calls ($P<0.01$) (Figure 3). There were no interruptions either preintervention or postintervention from the arrival of critically ill patients or trauma patients.

There was a higher mean number of patients handed off preintervention (12.9 vs 9.6 patients; $P<0.01$), but the total number of patients in the ED at the time of sign out was higher in the postintervention period (33.6 vs 38.6; $P=0.03$). Shift sign out occurred a mean of 6.1 minutes late pre-intervention, and 3.9 minutes late postintervention ($P=0.03$). Additionally, the total time spent during shift sign out was reduced (14.1 vs 11.4 minutes; $P=0.04$).

The survey results (Table) showed statistically significant improvements in clinician perception of interruption frequency as well as perception of overall sign out safety. "Top Two Box" Likert scores of 4 or

5 increased from 47.4% before implementation to 91.7% after implementation for provider perception of sign out safety.

DISCUSSION

Interruptions during shift sign out may be an underreported phenomenon. Our study found 1 interruption per 2.38 minutes during sign out (during the preintervention phase), which is higher than previously reported rates of interruption.[4] The simple interventions through which we were able to reduce interruptions are only a few of the many possible ways to move toward this goal. We demonstrated that very low cost and easily implemented interventions can reduce the rate of interruptions by over 80%.

The increased awareness that shift sign out was occurring provided by the overhead chime and visible signage seemed to lead to greater hesitation to interrupt the shift sign out process. This also seemed to lead to a change in the culture of sign out, evidenced by the increased provider perception of the safety of sign out as well as secondary metrics, including the duration and start time of sign out.

With so much recent attention on the safety risks associated with patient handoffs in medicine, it is not surprising to see a resultant surge in research focused on improving this process. This includes the Emergency Medicine Patient Safety Foundation's ED-specific *SAFER Sign Out* guideline, in addition to other patient sign out guidelines.[11,12] While these handoff "checklists" focus on improving the content of sign out, to maximize the effect of these tools, the context of the sign out also is important and must occur in an environment optimized for the communication of patient data.

Although some interruptions could be perceived as necessary to delivering safe and efficient ED care (ie, for critical patients), any benefit must be weighed with the risk during the already high-risk sign out period.[14-16] It is unclear that minimizing interruptions has any positive effect on patient outcomes, although our clinicians did perceive that overall safety of sign out had improved due to the intervention (Table).

The physician station in the ED could be compared to the cockpit of an aircraft. The aviation industry is viewed as the gold standard in the utilization of similar safety checklists. In addition to the content of the safety checklists, there is emphasis on the idea of implementing a "sterile cockpit" during recognized high-risk times such as takeoff and landing,[17] with interruptions limited only to critical information. The fast pace, unpredictable nature, and frequent interruptions make the ED a similarly high-risk environment less than ideal for effective transfer of information.

Health care systems should consider working toward the idea of a "sterile cockpit" in the ED during our most vulnerable times—patient handoffs. Only those interruptions that are truly critical should occur during these times.

Limitations

This study was conducted as a before-and-after study design and was not randomized. We selected observation times on similar days of the week and times of the day to avoid potential confounding, but there could be other variables not controlled for that influenced the results. One of these variables—discussed in the results section—was that the volume of patients in the department signed out at shift change was higher during the postintervention period. However, this would be expected to negatively impact the results.

In this study, the data recorder was present during sign out. Although the clinicans signing out were not aware of the specific variables being collected, they were aware that they were being observed, which could have influenced their behavior.

Due to the rotation schedule of resident physicians, there also were slightly different providers working in the ED during the pre- and postintervention periods. The 24 faculty stayed consistent, but there was turnover in 10 of the 18 residents due to off-service rotations, meaning that there could have been a potential difference of up to 26% in the providers responding from the presurvey to the postsurvey.

As with any change in a complex system, it is also difficult to assess inevitable unintended or downstream consequences.[18] It is possible that these interventions, while reducing interruptions during sign out, led to interruptions in nurses' workflow or the omission of communication of patient data between nursing or consultants and the ED care team.

While we used a decrease in interruptions and provider perception of safety to demonstrate potential safety improvements, we did not investigate the effects of our interventions on actual patient outcomes or adverse events. Further study would be warranted in these areas. Patient perception of sign out safety and communication of information between physician teams also would be an interesting topic of investigation.

CONCLUSION

This study demonstrates that following implementation of very simple interventions, there was a significant reduction in the frequency of interruptions occurring during ED shift sign out as well as increased provider perception of sign out safety. Optimizing the ED environment for shift sign out could allow for more successful communication of critical patient information and ultimately could lead to improved patient safety.

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